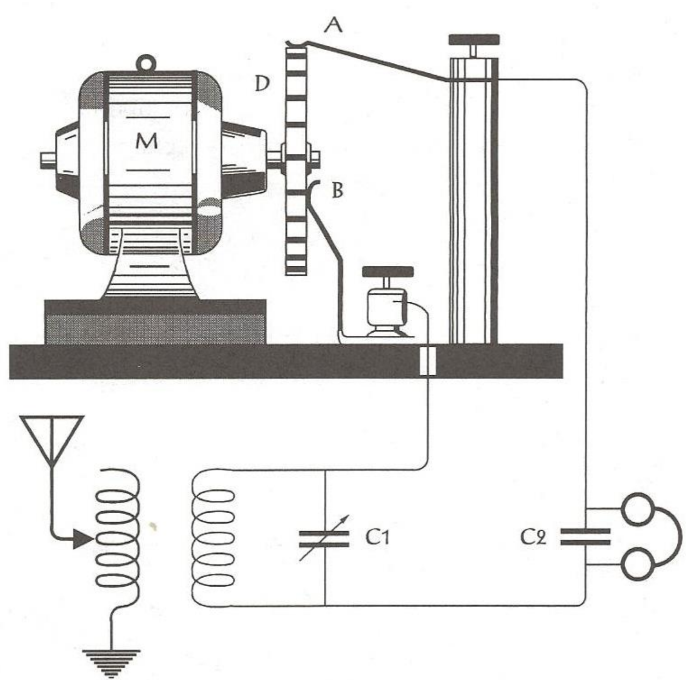
THE TIKKER DETECTOR REVISITED –
THE BEGINNING OF RADIO TELEGRAPHY
By Phil Anderson, WØXI

In the early days of radio telegraphy, designers initially applied existing land-line telegraph circuits to copy continuous radio frequency waves. For example, a coherer was used to detect RF dits and dahs and the resulting current would cause a holding relay to stay closed until the dit or dah was completed. A sounder was used to report a “click” at the beginning of the dit or dah and a “clack” at the end as the RF pulse ceased. Someone then thought of placing earphones across the holding relay in order to get more volume.

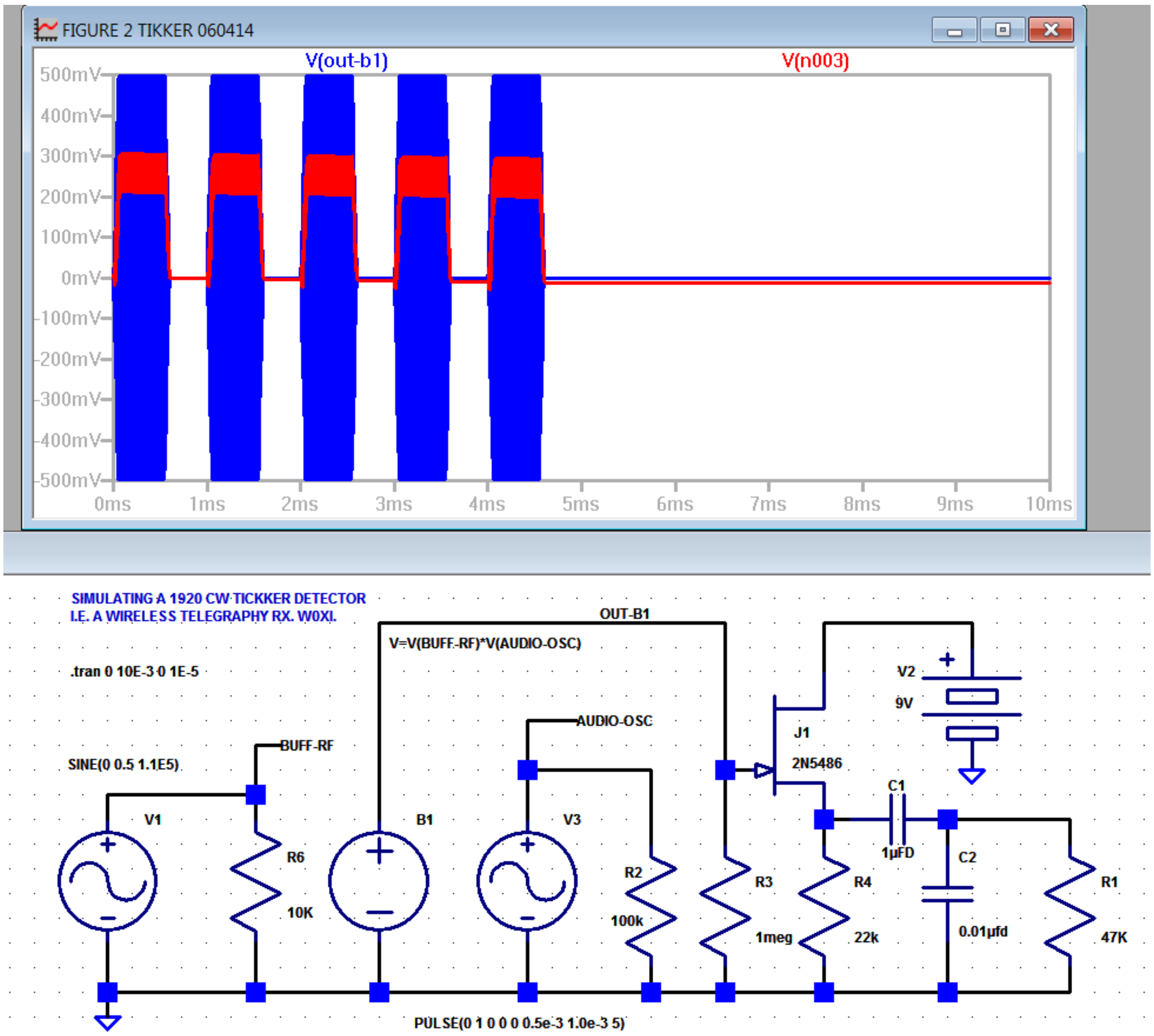
The next enhancement came when Poulsen (1) thought of using a chopper – also called an interrupter or tikker. He reasoned that to make un-damped radio frequency oscillations audible, one was “compelled to break up the oscillations in the headphones at an audio rate.” With this addition, the dots and dashes sent could be heard more clearly, using a chop frequency of 300 to 1000 Hz. Note that this technique is not the same used in our modern day direct conversion receivers, wherein one mixes the RF signal with a local RF oscillator signal to create an audio beat note.



The schematic of the Poulsen Tikker is shown in Figure 1. The antenna and tuned circuit are shown at bottom left. C1 is used for RF tuning. The chopper consisted of a motor and timing wheel, with a constant connection from the tuned circuit to the flat surface of the wheel at B and an interrupting contact on the edge at A that feeds the phones. The dits and dahs arriving at the tuned circuit were literally chopped at an audio rate. The equipment delivered a reasonable audio tone after chopping, like those you’d hear today with a modern rig! Keep in mind that the frequency of carriers in those early days was typically from 40 to 100 kHz! In addition transmit power levels where quiet high as compared with low power (100W) and QRP power (5W) used for amateur CW transmissions today.

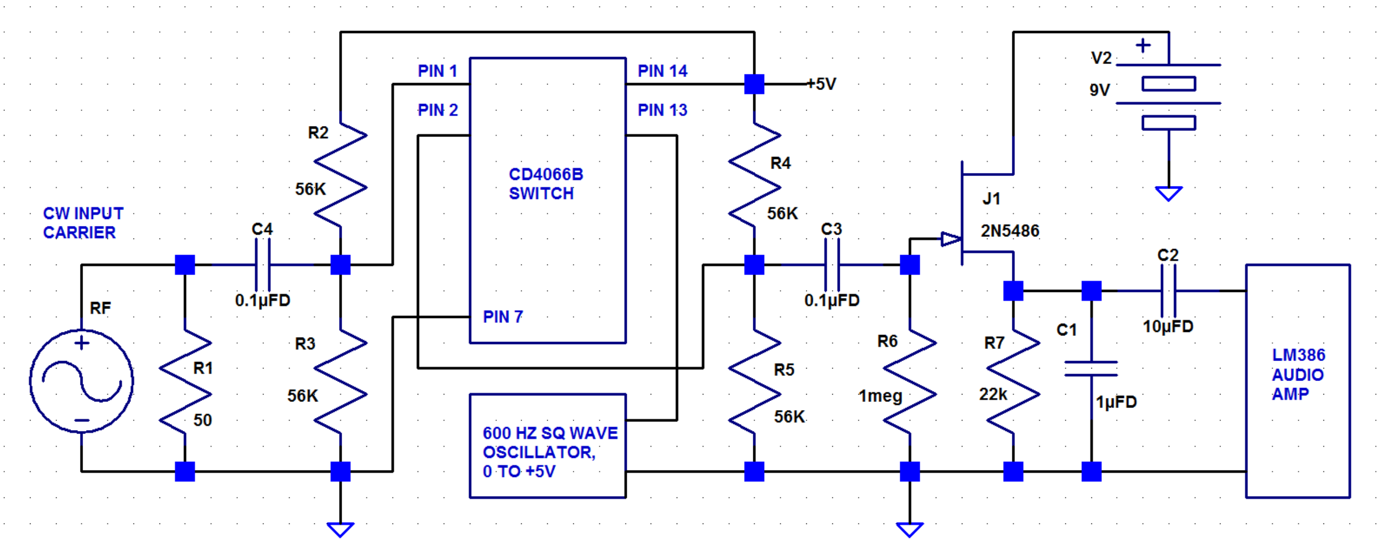
A MODERN DAY TIKKER

After revisiting this material on the Tikker, I decided to try building a modern version and testing it on the bench, using a signal generator and code key as the source. As with all electronic projects, I like to simulate them in software first and then build the hardware. This often saves overall project time and usually builds on a deeper understanding of results. Figure 2 shows a wave/signal result and associated pseudo-schematic.



The signal generator, V1, is shown at bottom left in the schematic. I multiplied the output of the generator with a 500 Hz square wave (0 to 1 VPP) that lasted for 5 ms and ran the simulation for 10 ms, thus simulating the action of the chopper wheel. The resulting multiplication is reported by block B1, a behavioral source; and the result is shown as V(out-b1) in the software graph at the top of the figure. Clearly one sees the results of chopping the RF signal five times and then leaving it open. Finally, I added a JFET detector with the output at the source lead. The detector, of course, presents the envelope of the RF as audio. We'll discuss why I added this in a bit.

The schematic for my actual wired circuit and a picture of the bench build are shown in Figures 3 and 4. Let's take a walk through the schematic first. A BK Precision 4017B is shown at left and labeled "RF." The chopper features a CD4066BCN IC switch and 500 Hz, 3-gate 74HC14 inverter oscillator (2). The JFET detector and an LM386 audio amplifier complete the circuit. Let's focus on the switch. Plus and minus supplies or biasing of the input and output signals must be supplied to switch AC signals. I didn't want to mess with a -5V supply so I AC-coupled and biased the input and output at pins 1 and 2. The audio square wave drives the clock input at pin 13 with a 0 to 5VP signal. The square wave can be implemented in a number of ways, using three 74HC14 inverts, using a 555 timer, a PIC, and so on.

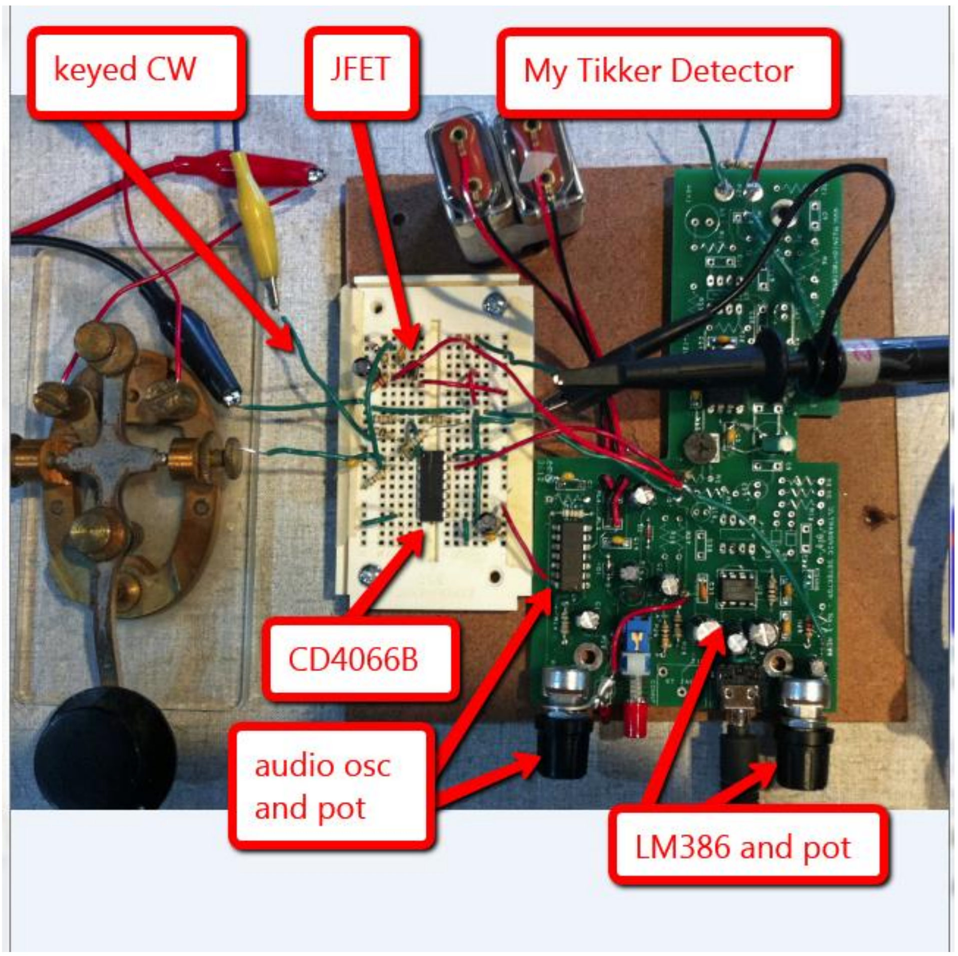


How does the output sound? Actually it sounds pretty good. With the generator set for 100 mvpp and the local oscillator set at 500 Hz, I varied the RF frequency and mvpp of the RF signal and keyed in a few CQs for a variety of frequencies. For the circuit of Figure 3 – with the output taken from the detector - the code sounds fine with RF carriers of 2 MHz, 200 kHz, even 20 kHz. With a carrier at 2 kHz we get a buzzing sound. This is as expected when the input carrier and oscillator frequencies are too close together. With the output of the chopper taken directly to the LM386 audio amp, i.e. bypassing the JFET detector and receiving a waveform like that in Figure 2, the code sounds good with a carrier of 2 MHz but the volume is down some. In addition, the code is grainy sounding below 200 kHz, again with less volume.

Now recall that the Tikker in Figure 1 had no detector added ahead of the phones. I had wondered what that would sound like. Now we know. It works but not as well as when a detector is added.

To listen to our Tikker, download the file titled TIKKER-AUDIO from our downloads page at https://www.midnightscience.com/article-index.html . You'll hear four CQs, the first at 2.0 MHz, and the last at 20 kHz. The last one sounds raspy.

Next step? I hope to find the time to add a tuned circuit front end and see if I can copy any local CW traffic across town on 40 meters. "Look Mom! No local RF oscillator!" Or perhaps I should have said, "Look Grandma! No local RF oscillator!"



(1) Bucher, Elmer, Practical Wireless Telegraphy, Part XV, page 278, 1917.
(2) Google the CD4066BCN IC and the 74HC14 invertor for pin outs and app notes. Vendors carry these parts today.